NASA Best Project:
Human Research Facility
Rack 2

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NASA/JSC

Project Management Shared Experience Program 6
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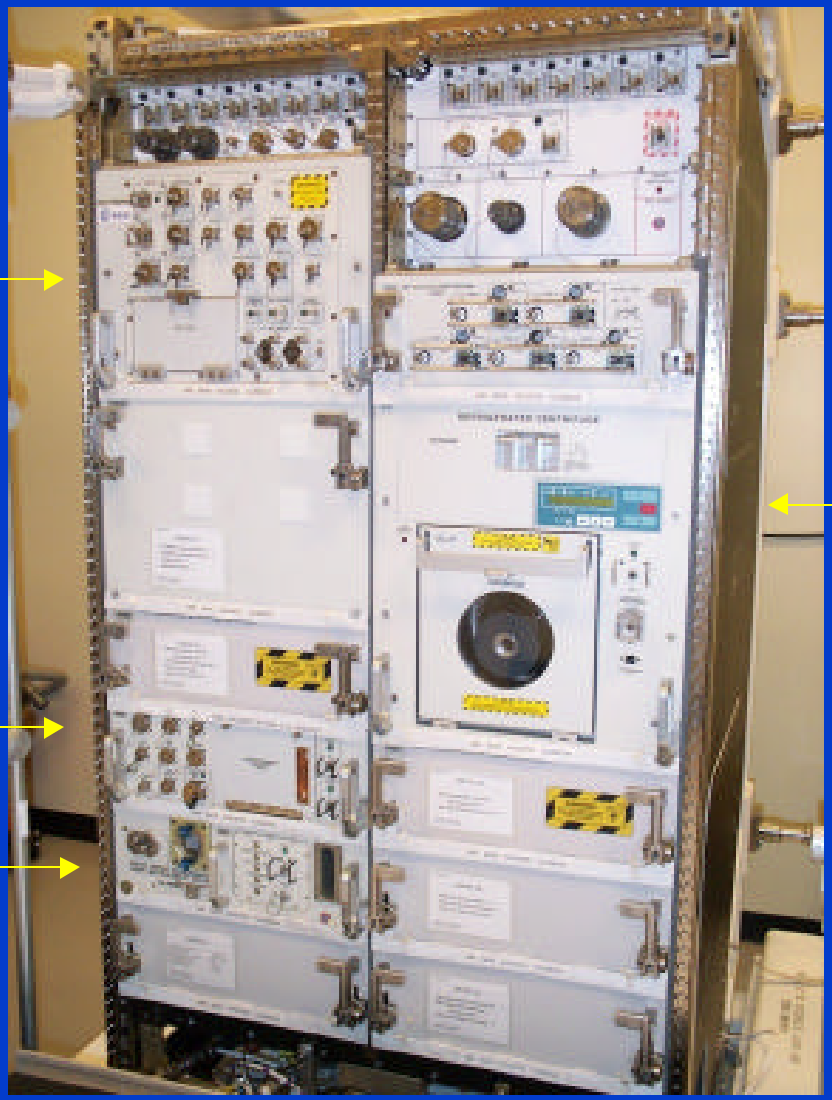
Overview

- The purpose of the Human Research Facility (HRF) is to provide an on-orbit laboratory for conducting in-flight research experiments to study human physiological, behavioral, and chemical changes induced by spaceflight.
- Data gathered will provide insight into the adaptation of crewmembers to ensure crew health and performance for future exploration and return to Earth.
- The HRF is the first ISS Facility Class Payload
  - HRF Rack 1 launched March 8, 2001, on STS-102/Flight 5A.1
  - HRF Rack 2 to launch on STS-114/Flight ULF 1 in March 2003

HRF Rack 2



Pulmonary Function System

Rack 2 Workstation

Mass Measurement Device

Refrigerated Centrifuge

HRF Rack 2 Building Blocks

- Develop Components
  - Outfitted (Empty) Rack 2
  - Pulmonary Function System (PFS)
  - Rack 2 Workstation (R2WS)
  - Refrigerated Centrifuge
  - Space Linear Acceleration Mass Measurement Device (SLAMMD)
  - Stowage
- Integrate and Test
- Complete Verification

Outfitted Rack 2

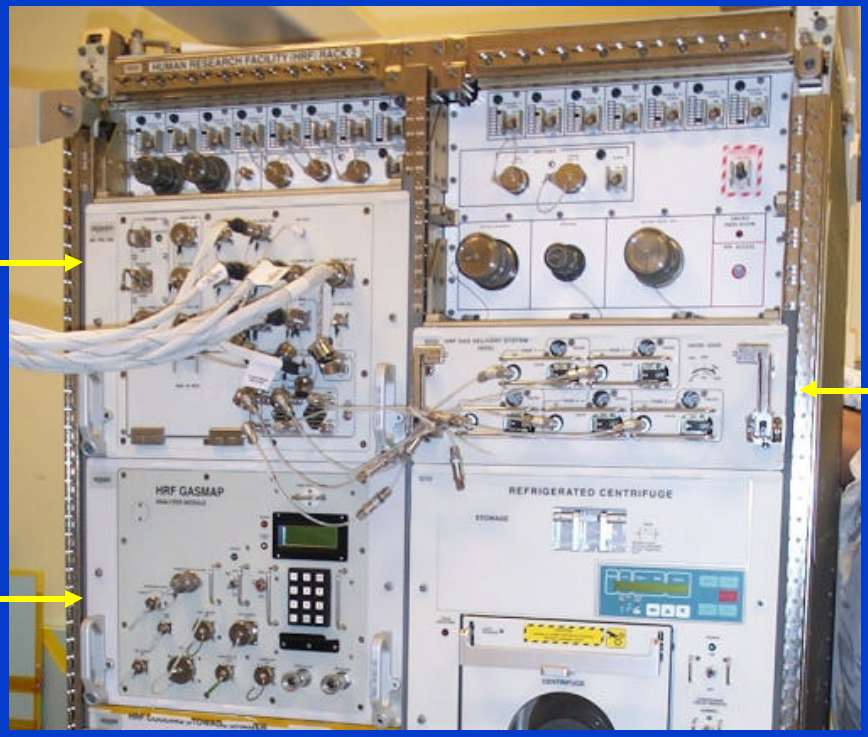
- Provides structural, power, thermal, command and data handling (C&DH), and communication and tracking (C&T) interfaces between the HRF and US Lab
- Empty Flight Rack 2 fabricated by MSFC/Boeing and received August 16, 2001
- Opportunities for Success
  - Receipt of rack from non-HRF group
  - Modifications to facilitate integration and operations
    - Acoustic abatement
    - Bracket installation and modification
    - Labeling

Pulmonary Function System (PFS)

- A collaborative development between ESA and NASA in pulmonary physiology instrumentation
- Opportunities for Success
  - Schedule and technical coordination

ESA - Pulmonary Function Module (PFM) / Photoacoustic Analyzer Module (PAM)

NASA - Gas Analyzer System for Metabolic Analysis Physiology (GASMAP)



NASA - Gas Delivery System (GDS)

Rack 2 Workstation (R2WS)

- High-end computer to process, collect and synchronize mass quantities of data
- Opportunities for Success
  - Integration of commercial-off-the-shelf computer components
  - Flexible mass storage – SCSI, PCMCIA, and IDE drives
  - Software compatibility

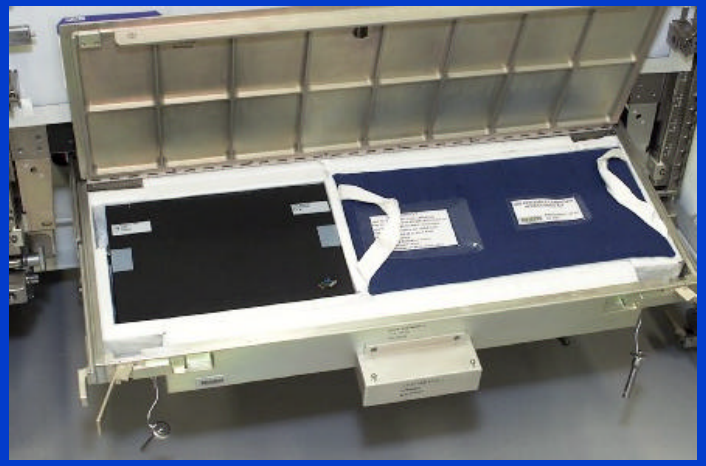
Refrigerated Centrifuge

- Mechanical device to separate biological substances of differing densities
- Maintains a rotor chamber temperature of +4 ºC
- Opportunities for Success
  - Significant technical development of an oil-free compressor
  - Custom-built power supply

Space Linear Acceleration Mass Measurement Device (SLAMMD)

- Measures the on-orbit mass of humans from 90 to 240 lbs within 0.5 lbs
- Opportunities for Success
  - µg-dependent design
    - Mir
    - Detailed Test Objective STS-89
  - Accuracy and precision
    - Unique software
    - On-orbit calibration
  - Component selection and integration
    - No active air exchange
    - Redundancy of all key components

Stowage



- System of drawers, kits, and foam to stow HRF component accessories
  - 5 4 Panel Unit (PU)International Subrack Interface Standard (ISIS) Stowage Drawers
  - 2ea Cooling Stowage Drawers
  - 2ea 8PU Stowage Drawers
  - 1ea Rack Utility Drawer, at base of rack
- Opportunities for Success
  - Receipt of drawers and stowage from HRF and non-HRF groups
  - Stowage layouts

HRF Rack 2

683-46051-4

HRF Mods

SEG46118352-301

Outfitted Rack

Instruments

SEG46118353-301

Empty Rack

Certified by Boeing EXPRESS/MSFC through FCA/PCA

Outfitted Rack

Certified at JSC through ADP/GCAR Process

Instruments

Certified at JSC through ADP/GCAR Process

Integrated Rack

No Unique Certification Package

Verified via UPVP Process

Integrate and Test

- Each HRF Rack 2 component completes design, drawings, fabrication, assembly, acceptance and certification testing, and verification data packages
- Component hardware and software delivered to the Launch Package Integration Team for software integration and system testing
  - Utilize the Payload Rack Checkout Unit (PRCU) provided by MSFC/Boeing
  - Mechanical, power, thermal, C&DH, C&T, and science verification testing
- Opportunities for Success
  - Operation of PRCU at JSC
  - Tracking and coordination of hardware and software
  - Test plans and procedures
  - Delivery for flight

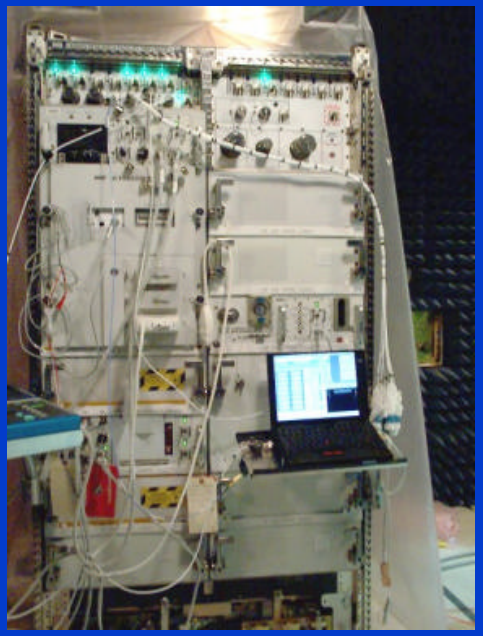
HRF On-Orbit

- Once on-orbit and installed, HRF Rack 2 will be reconfigured by exchanging instruments with HRF Rack 1, creating configurations Flight Rack 1A and 2A. The two new configurations and launch configuration are shown below:

FR2 Launch

FR2A On-Orbit

FR1A On-orbit



Complete Verification

- HRF requirements to the ISS are identified in interface requirement documents and payload verification plans approved by the ISS Payloads Office
- With the launch of HRF Rack 2, verification was required of both on-orbit rack configurations. Data required at L-7.5, L-3.5, and L-3 months.
  - Rack 1A ISS Verification = 326 requirements
  - Rack 2/2A ISS Verification = 375 requirements
- Opportunities for Success
  - Ensuring tests and analyses meet requirements
  - Processing waivers and exceptions
  - Volume of paperwork

HRF Rack 2

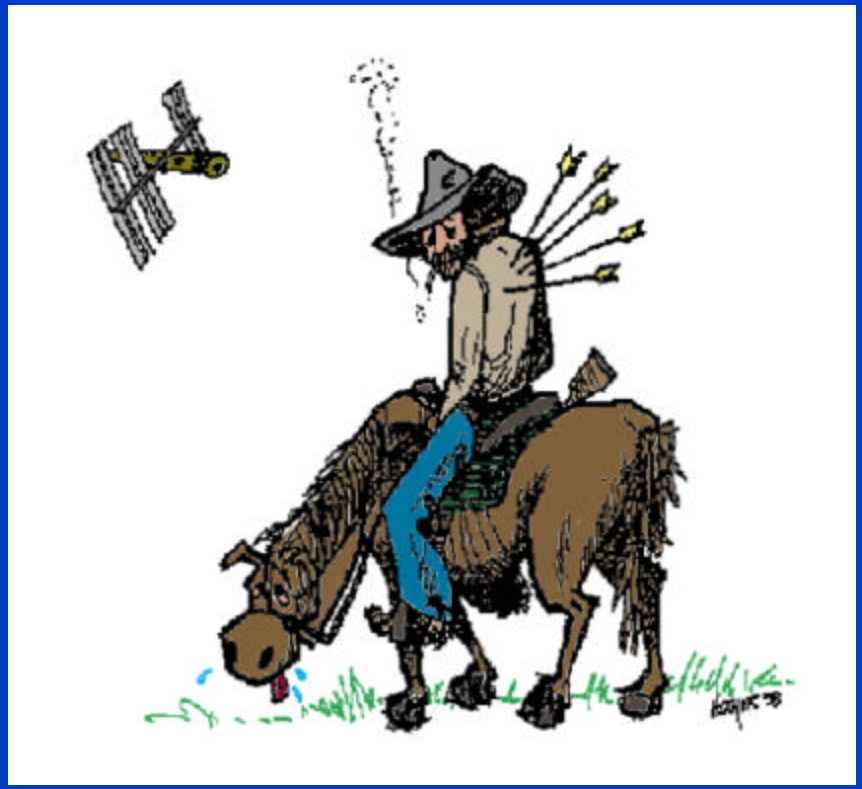
- HRF Rack 2 is a product of:
  - Successful technical development
  - Resolution of issues with HRF and non-HRF provided systems
  - Significant schedule and technical coordination
  - Communication
  - Meeting customer requirements
    - Science community
    - Medical community
    - ISS Program

“Best Project” Qualities

- TEAM!
- Incorporate Lessons Learned
- Cost Effective Solutions
- Proactive Approach
- Ability to React, Replan, and Implement
- Innovative Thinking
- Perseverance
- Attitude of Ownership and Responsibility
- Communicate, Communicate, Communicate
- TEAM – Driven to succeed and does!

HRF Rack 2 Team

Project Management



- LM PM - Jerry McDonald
- Rack 2 - Elton Witt
- Integration - Kevin Upham, Margaret Klee
- Verification – Jim Thompson
- PFS - Clifton Amberboy, John Ives, Mete Yalcinkaya
- R2WS – Keith Tucker
- RC - Sharon Campana
- SLAMMD -Geoffrey Coen
- Stowage - Dan Barineau

Incorporate Lessons Learned

17 MONTHS

12 MONTHS

Rack 2 O/D KSC

2003

8/02

3/03

2002

ULF-1 Launch (FR2)

5A.1 Launch

3/8/01

SVT 6/02

JEM I/F Test 1/03

Rack 1 O/D KSC

2001

MEIT/ETE

1/00

9/13/00

8/16/01

Rack 2 O/D JSC

Rack 1 O/D JSC

2000

5/99

4/00

11/00

Phase III Safety Review

SVT 8/00

MPLM Installation

LP1 Delta CDR

11/98

Rack 1 System CDR

1/98

1999

6/99

MEIT

1998

1997

Rack 1 PDR

6/96

1996

Cost Effective Solutions

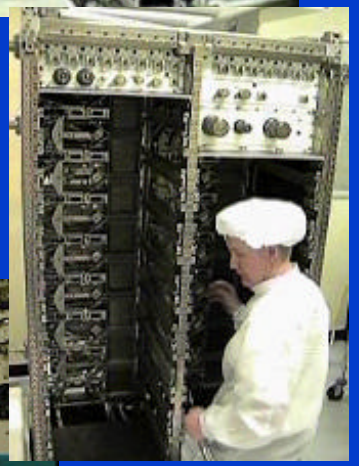
- Developed a second training rack in less than four months to begin crew training
- Solution used mechanical structure of existing ground rack and a switching system for dual use of the Rack Interface Controller

Proactive Approach

- **The PFS required considerable schedule and technical coordination, regardless of ESA or NASA-provided. Team worked to incorporate software, hardware, and label changes prior to delivery.**

Ability to React, Replan, and Implement

- Workarounds required to accommodate significant disruptions to the integration schedule
  - Major upgrades in the US Lab simulation systems
  - Troubleshooting of non-HRF provided systems
  - Investigation and successful resolution of Rack 1 in-flight anomalies
- Integration schedule annotated with daily revision letters



Innovative Thinking

- Utilize custom foam for long-term stowage
- Generic drawer liners implemented for HRF Rack 2 (and Rack 1) to minimize wasted volume and allow for flexibility to reconfigure contents
- Crew continuously compliments HRF stowage during reviews

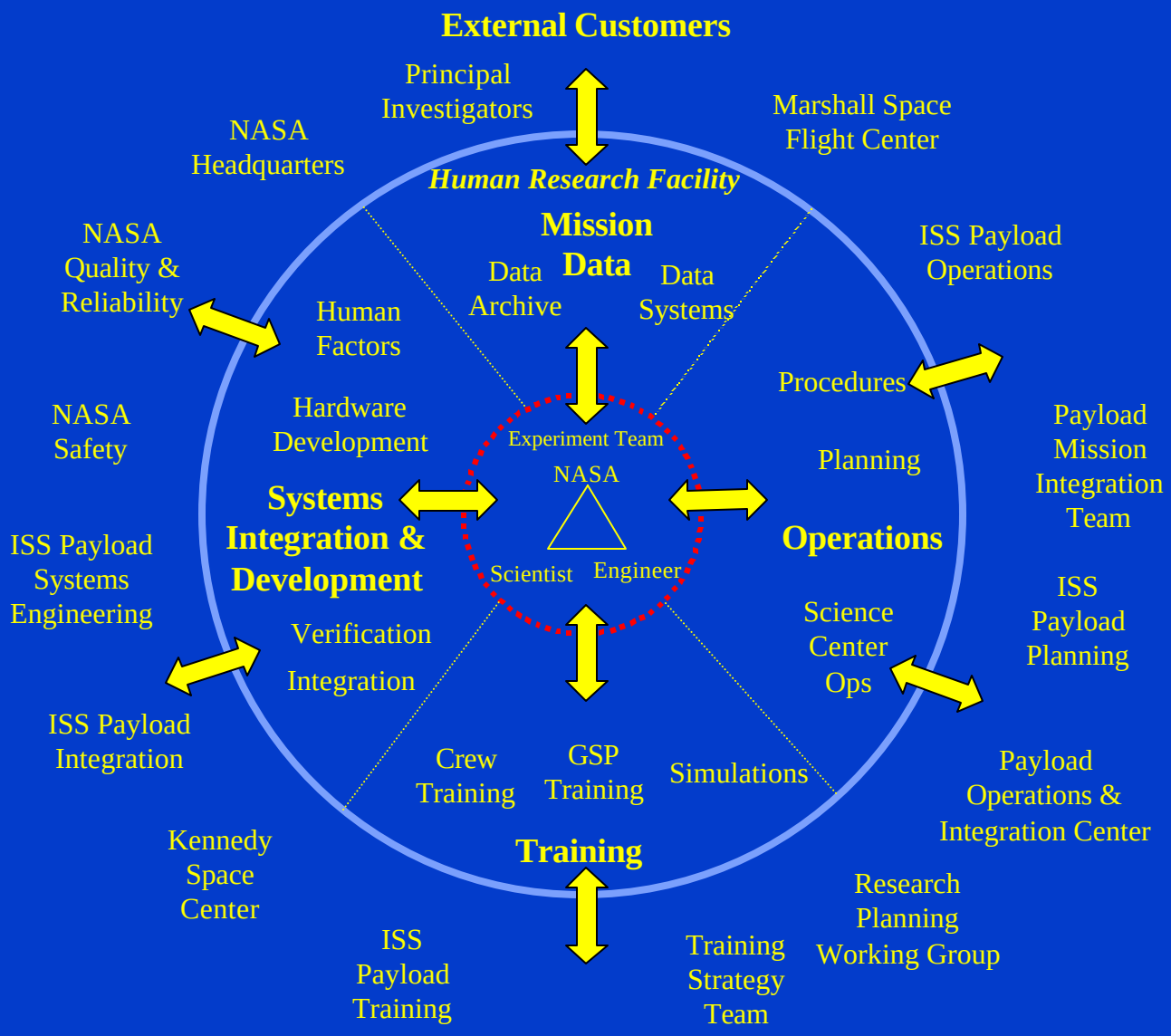
Perseverance

- Project experienced several technical obstacles with the power supply and compressor
- Implemented recovery plan of a backup compressor design but did not for the power supply
- Still part of HRF Rack 2 because of technical expertise and team motivation

Attitude of Ownership and Responsibility

- Accept NASA and LM systems with associated bureaucracy and work within those processes. Any outside-HRF group viewed as a "customer."
- Many members accepted much larger tasks and more responsibility than in the previous flight rack.
- Team culture – forgiveness of mistakes, coordination within and outside project, focus on priorities.
- The team demonstrated an unwavering commitment to project success.
- From managers to technicians to administrative staff - across all tasks - the team truly worked as an ensemble.
- The hallmark of the HRF Rack 2 project was to prevent crises and overcome obstacles and problems with the efficiency and confidence of a highly focused and dedicated team.

Communicate, Communicate, Communicate



HRF Rack 2 Team

Best Team!